cumulus or stratus formation, and after September 17, when the drought was partially relieved by a fair rain, no distinctive types of the cumulus clouds were observed. September 17 was apparently the turning point or transition period between summer and fall conditions, and although the drought continued through October, the clouds observed were of a radically different type. Strato-cumulus and stratus types prevailed, with an apparently increasing amount of upper clouds.

The inclosed photographs[1] will give a fair idea of the cumulus types referred to. The clouds shown in the photographs are apparently typical cumulus or "fair weather clouds," and proved to be especially characteristic of dry summer weather conditions in this locality during 1899. Two cloud pictures were taken later and exhibit more of the stratus type. They were at a less elevation than the cumulus types and were moving in a different direction from the upper cumulus clouds. They also, as will be seen from the photographs, appear darker with a more broken outline and had apparently settled down from the cumulus clouds. The characteristic differences can be detected more readily from the photographs than from any description.

These types of clouds were particularly indicative of fair settled weather during the summer of 1899. No rain occurred within three days following such types of clouds, and in one example given (photograph B) no rain occurred within the following week.

During the summer of 1898 very few distinct types of the cumulus clouds were observed and the records show the heaviest rainfall ever observed at this station. A series of photographs or cloud observations during wet and dry seasons will doubtless give valuable results. It will be necessary, however, to differentiate closely between cumulus and cumulonimbus types.

Many interesting queries are suggested by a study and comparison of the accompanying tabular data. Table 1 shows a small gradual increase in the amount of southeast wind from July to October for the years 1897 and 1899, and also indicates a decided increase in the rain deficiency, directly opposed to the theory that the direction of the wind has a modifying effect upon the rainfall. In Table 2 we compare the average number of times rain followed winds from the north, northeast, east, etc., for a period of ten years, with the actual number of such rainy days during 1897 and 1899. The total number of winds from the different directions is also shown. The data given under annual average temperature departures for each wind (Table 2) agree substantially with the normal law of distribution of temperature with wind, and we find that a year with deficient rainfall gives an excess of temperature. The theorem that deficient rainfall gives an excess of temperature for this locality during the summer months, is strengthened by the long continuance of high temperature and southeast winds during 1897 and 1899. It will be observed that the average number of rainy days following winds from the southeast and northwest is larger than from other directions, and also that the southeast wind was followed by more rainy days during the years 1897 and 1899 than on the average, notwithstanding the deficiency in rainfall during those years.

A comparison of the different tables shows so many exceptions to preconceived ideas that any attempt to reconcile the discordant elements only emphasizes the old adage that "all signs fail in dry weather." When terrestrial signs fail what then remains? In the opinion of the writer the solution, not only of this problem but of many more pertinent questions in meteorology, must be sought for higher up. The great bulk of the upper air still remains an unexplored territory, and it is to this region we must turn.

[1] The Editor regrets that these photographs do not admit of reproduction as half-tones.

TABLE 1.

Months.	Number of observations of southeast wind.					The rainfall.				
	Normal.	1897.	Departure.	1899.	Departure.	Normal.	1897.	1899.	Average, 1897-99.	Departure.
May	14	21	+ 7	17	+ 3	6.18	2.48	6.72	4.60	— 1.58
June	15	20	+ 5	20	+ 5	4.58	5.36	5.24	5.30	+ 0.72
July	15	10	— 5	10	— 5	4.63	2.48	1.48	1.98	— 2.65
August	16	10	— 6	20	+ 4	4.01	1.48	0.75	1.12	— 2.89
September	16	27	+11	15	— 1	3.96	0.37	1.06	0.72	— 3.24
October	17	30	+13	19	+ 2	2.41	0.93	5.41	3.20	+ 0.79

TABLE 2.

Direction.	Annual wind frequency.				Annual average temperature departure for each wind.	
	In general.	Followed by rain.				
		Normal.	1897.	1899.	Normal.	1897-99.
					°	°
North	82	20	21	21	— 36	— 44
Northeast	67	18	8	18	— 19	— 30
East	61	15	8	8	+ 8	+ 8
Southeast	192	28	32	30	+ 46	+ 50
South	133	22	17	22	+ 42	+ 48
Southwest	64	12	8	3	+ 19	+ 29
West	43	8	8	11	— 2	— 5
Northwest	90	17	21	21	— 45	— 45
					+115	−124
					−102	+135

THE CLIMATOLOGY OF HAVANA, CUBA.[1]

By Dr. ENRIQUE DEL MONTE, dated January, 1898.

I.—LOCATION AND APPARATUS.

1. The Meteorological Observatory of Havana was erected in 1886 in the Vedado Park, lying in a western and most fashionable quarter of the city. The building had all the requisites necessary for the work for which it was destined—it was well isolated, the main floor was 30 feet above sea level, and about 350 yards from the sea shore—so that the circulation of the air was perfect, and free from the radiations so commonly affecting this kind of work in large cities. The installation of the thermometers and psychrometers was the object of great attention and study, and was accomplished in the following manner: On the flat roof or platform of the building a small room was erected (8 feet across) of an octagonal shape, surrounded with venetian blinds, at an angle of 45 degrees, and roofed with a mixture of plaster of paris, so as to render it more obstructive to the heat than the ordinary roof painted with white lead. In this way the temperatures taken are, we believe, correct.

2. To our great surprise we have often seen in encyclo-

[1] Many years ago a school of agriculture was founded at Havana under the special patronage of the Count of Casa Moré, President of the Society of Planters. Its courses of instruction were under the direction of able professors, and there were attached to it experimental conveniences, a meteorological observatory, and other evidences of scientific work. The events of the past few years have apparently checked the good work begun at that time, but the need of such an institution as the modern college of agriculture and agricultural experiment stations is greater than ever, and we are pleased to learn that Señor Biscay and Don Manuel Calvo have offered to cooperate with the Cuban government in the establishment of a new school of agriculture.

The meteorological observatory of this college was suggested by Count Moré in July, 1886; the idea was realized through the enthusiastic assistance of shipowners and planters; among them the Count of Morteva and Messrs. Arrieta, Ibañez, Mesa, Alfonso, M. Artiz, and numerous merchants were prominent donors. Dr. Enrique del Monte, a professor in the Havana University, was chosen director of the new observatory, which was inaugurated on January 1, 1887, under the auspices of the agricultural college. The director promptly began to establish substations throughout the island, but apparently accomplished this only in part, in the eastern and western ends of Cuba. Early in

pedic almanacs, printed in foreign cities, temperatures assigned to Havana (both extremes and means) that are always too high. We do not know the source from which this information has been taken, but we suppose it has been from the summaries published by some private observatories. As a general rule, we have seen the thermometers defectively installed, the system being the old one, long ago rejected, of a very small shelter, perhaps no more than 2½ feet square, attached to a northern wall of the building. Such an installation is always objectionable, but still more so in tropical countries, where the sun reaches a great altitude at the summer solstice. In these cases the sun's rays strike the shelter in the hottest hours of the day, and it frequently happens that as southerly winds are blowing then, the thermometers are out of the circulation of the air, and at the same time subjected to the enormous radiation of the shelter itself; the maximum temperatures are, therefore, erroneous. Regarding the minimum temperatures in Havana, such an installation is still more objectionable, inasmuch as the prevailing directions of the wind from 7 p. m. to 9 a. m., are from southeast to southwest. As a good illustration of this particular, we will only refer to two cases, occurring in the first year of the establishment of our observatory—1887. In the meteorological summary for that year, published by the Observatory of the Royal Belén College, Havana, we find that the maximum temperature of the year occurred on the 28th of August, at 2 p. m., and it was 96.6°. According to our summary, that really was the hottest day in the year, but the maximum thermometer in our observatory only reached 90.5°. The same summary for Belén shows that the wind's direction, from 6 a. m. to 4 p. m. on that day, was south-southwest. In connection with the minimum temperature, we find that according to the Belén summary, for 1887, the coldest day in that year was January 5, the thermometer reaching 49.6° at 4 a. m. That was, certainly, the coldest day in the year, but we got as a minimum 45.1° at Vedado Park. South-southwest winds were then blowing all over the city.

3. To return now to the installation of the instruments, we will next refer to that of the anemometers, wind vane, rain gage, atmidometer, and sunshine recorder.

4. The two anemometers and the wind vane were erected on the flat roof, upon supports 11, 14, and 15 feet high, respectively. The rain gage, atmidometer, and sunshine recorder were adequately installed in the same place.

5. Below is the list of the principal instruments we had in use within the observatory:

Two mercurial barometers, Fortin's system, of 0.8 and 0.6 inches internal bore, respectively; provided with English and French scales, the verniers reading 0.002 of an inch, and 0.05 millimeters. These barometers were of the manufacture of Negretti and Zambra, of London, and were accompanied with certificates of verification made at the Kew Observatory.

A self-recording aneroid barometer of the manufacture of Richard Frères, of Paris.

Two maximum thermometers, made by H. J. Green, of Brooklyn, N. Y.

Two minimum thermometers of the same maker.

A self-recording thermometer, of the manufacture of Richard Frères, of Paris, working in connection with an electrical register of the same manufacture.

Two psychrometers, made by H. J. Green, of Brooklyn, N. Y.

A self-recording wind vane and anemometer, also an anemoscope of Richard Frères, of Paris. This latter instrument electrically registers sixteen wind directions and the mean velocities in kilometers per hour.

An anemo-cinemograph, of Richard Frères, of Paris. This instrument gives the absolute maximum velocity of the wind in meters per second and is necessary in ascertaining the velocities of the gusts in the hurricanes.

A self-recording rain gage of Richard Frères, of Paris.

Besides these instruments, we had in the observatory the following miscellaneous apparatus:

An equatorial telescope, object glass 108 millimeters diameter, with diagonal eyepiece, micrometers, spectroscopes, and photographic equipment, all of the manufacture of Secretan, of Paris.

A theodolite, of Troughton & Simms, of London.

An astronomical clock, with mercurial cistern, manufactured by Gordon & Co., of London.

A ship's chronometer, of T. S. & J. D. Negus, of New York.

A transit instrument, of Troughton & Simms, of London.

II.—TEMPERATURE OF THE AIR.

6. The daily mean range of the temperature at the Vedado Park Observatory, Havana, during the month of January, as computed from nine years' observations (1887 to 1895, inclusive), is 9.2°. The minimum temperature in this month, occurring about 6 a. m., is on an average 65.2°. The maximum averages 74.4°, and generally occurs shortly before 2 p. m.

Mean annual and monthly temperatures in Havana, 1887 *to* 1895, *inclusive.*

Month.	1887.	1888.	1889.	1890.	1891.	1892.	1893.	1894.	1895.	Means.
	°	°	°	°	°	°	°	°	°	°
January.	68.3	71.5	71.8	73.0	68.9	69.0	66.7	70.1	69.0	69.8
February	73.7	72.1	71.7	73.3	73.1	70.6	72.5	71.9	66.5	71.7
March.....	72.0	73.5	71.8	72.3	73.6	71.0	73.0	72.5	73.0	72.5
April.....	76.1	75.0	76.0	76.1	74.5	76.0	77.0	75.0	74.5	75.6
May.	79.0	78.0	78.7	78.9	76.9	78.1	78.6	76.3	77.5	78.0
June	79.1	80.3	81.3	81.0	81.9	80.0	80.5	79.5	81.5	80.6
July.....	82.3	81.9	81.6	81.3	82.7	81.9	82.5	81.7	83.5	82.2
August...	82.5	83.5	81.5	80.5	82.1	81.4	80.0	81.0	80.6	81.5
September....	80 5	80.0	81.7	79.5	80.8	80.6	79.7	80.4	81.0	80.5
October.....	78.0	78.3	76.6	78.7	75.5	76.5	78.1	76.0	77.9	77.3
November	73.1	74.7	75.6	74.1	73.4	72.3	73.3	73.7	74.3	73.8
December....	71.0	69.9	69.7	69.5	71.5	70.5	70.5	70.5	69.0	70.2
Means.....	76.3	76.5	76.5	76.5	76.2	75.6	76.0	75.7	75.7	76.1

Absolute maximum and minimum temperatures for the respective months from 1887 *to* 1895, *inclusive.*

Month.	Max.	Year.	Min.	Year.	Month.	Max.	Year.	Min.	Year.
	°		°			°		°	
January.....	81.1	1895	45.1	1887	July	95.5	1891	69.5	1892
February	85 0	1890	49.7	1895	August	93.9	1888	69.5	1894
March	88.5	1887	51.0	1890	September ..	93.7	1893	68.7	1890
April	90.3	1887	50.0	1891	October	89.0	1888	59.0	1890
May	93.9	1895	62.3	1891	November...	84.1	1894	53.1	1887
June.....	95.3	1891	67.3	1888	December ...	81.9	1887	49.5	1894

7. In July the daily mean range is 12°.0°, the minimum temperature being on an average 76.2° about 4 a. m. The

1888 he took an active interest in an unsuccessful effort to obtain funds from the Spanish Government for the exchange of daily cablegrams between the Spanish islands, on the one hand, and the Signal Office at Washington, D. C., on the other, hoping to establish useful forecasts of storms and northers. In August, 1889, a similar unsuccessful attempt was made; promises were favorable, but nothing was done. Meanwhile Mr. Luis G. Carbonell, of the Spanish navy and director of the Naval Observatory at Havana, undertook similar work, which is referred to in the Annual Report of the Chief Signal Officer of the Army for 1890, pages 12 and 216.

Owing to the internal troubles of Cuba, the active work at the Vedado Observatory ceased on December 31, 1895, and in January, 1896, the Director, del Monté, removed to New York City, leaving valuable apparatus stored in the public warehouse, where it was promptly destroyed by the Spanish populace; only that escaped destruction which had been placed in private custody. During his residence in the United States Dr. del Monté transcribed and arranged such records as had been saved from destruction, and in 1898 presented to the Chief of the United States Weather Bureau a memoir entitled: "The Climate of the Island of Cuba." The first portion of the memoir deals with the observations made at the meteorological observatory, formerly located at the Vedado Park, Havana, while the latter portion deals with the general question of hurricanes in Cuba. This latter will soon be published in a bulletin devoted to hurricanes, while the former portion we publish herewith, as containing climatological data for Havana that has hitherto been inaccessible to meteorologists.—ED.

maximum in this month averages 88.2°, between noon and 2 p. m.

8. The preceding table contains the monthly and annual mean temperatures in Havana for the years 1887 to 1895, inclusive:

III.—MOISTURE OF THE AIR.

9. The vapor tension at the Vedado Park, Havana, during the month of January, as computed from nine years' observations, is at a minimum, averaging 12.3 millimeters, about 6 a. m. The mean maximum is 13.7 millimeters, and generally occurs at 2:30 p. m.

10. In July the minimum tension averages 19.0 millimeters, about 4:30 a. m. The mean maximum is 21.1 millimeters, and occurs shortly before 4 p. m.

11. The maximum relative humidity at the Vedado Park, Havana, during the month of January, as computed from nine years' observations, averages 86 per cent about 6 a. m. The humidity is at a minimum at 2 p. m., averaging then 64 per cent.

12. In July the maximum generally occurs about 4 a. m., and averages 90 per cent. The minimum humidity in this month takes place between noon and 1 p. m., and is on an average 66 per cent.

IV.—PRECIPITATION.

Monthly and annual mean precipitation, and greatest precipitation, Vedado Park, Havana, nine years' observations, 1887 to 1895.

Month.	Mean.	Max.	Year.	Month.	Mean.	Max.	Year.
	Inches.	*Inches.*			*Inches.*	*Inches.*	
January	2.17	6.25	1889	August	5.65	9.30	1889
February	1.98	5.00	1889	September	7.29	13.01	1895
March	2.36	4.80	1891	October	9.50	13.60	1891
April	1.26	2.85	1887	November	4.50	7.50	1890
May	5.39	17.01	1890	December	2.15	5.65	1893
June	8.14	18.45	1892				
July	5 05	7.25	1890	Total	53.39		

V.—MEAN VELOCITY OF THE WIND.

The daily mean velocity of the wind, as computed from nine years' observations, shows intervals of calm attending the daily changes of direction. The secondary maximum occurs between 2 and 4 a. m., and on the annual average is 3.5 miles per hour.

The principal maximum velocity of the wind occurs between noon and 4 p. m., and averages yearly 11.5 miles per hour.

The daily absolute maximum velocity is on the annual average 17.5 miles per hour. The following table shows the mean velocity of the wind for each month of the year, as computed from hourly observations for nine years.

Month.	Miles per hour.	Month.	Miles per hour.
January	9.0	August	6.8
February	9.6	September	7.1
March	9.7	October	8.5
April	9.2	November	10.0
May	8.0	December	9.5
June	7.4		
July	7.0	Year	8.4

PHENOLOGICAL OBSERVATIONS ON THE POTOMA

By Prof. F. W. VERY.

At the special Weather Bureau station, temporarily established on Cobbs Island (post office address Rock Point, Charles County, Md.), Prof. F. W. Very reports the following notes relative to animal and vegetable life, under date of May 16:

The extremes of temperature have been rather trying. I have been interested in watching the spring changes and send you a few notes.

On my arrival (April 22) the following birds were already here: Red-winged blackbird, robin, bluebird, golden-winged woodpecker, brown thrush, long sparrow, swamp sparrow, chipping sparrow, boat-tailed grakle, meadow lark, warblers of several sorts, crows, sea gulls, killdee, plovers, turkey buzzards, the fish hawk, and swallows. Pear trees just coming into bloom. Cherry trees in full bloom. Shad bush in bloom.

April 25.—I walked through woods of pitch pine, long-leaved pine, and prickly holly, finding sassafras in bloom on the border and houstonia in the openings. Yellow warblers singing.

April 29.—Orchard oriole (new comer), green heron, king birds, far off heard song thrush, and rose-breasted grosbeak. Blackhaw (viburnum prunifolium) in flower all along the shore. Flowering cornel just beginning to bloom (columbine).

May 1.—Lilac in bloom.

May 2.—Pine trees in bloom and the waters of Neals Sound covered with pollen, thrown into wavy yellow veins (as in marbled paper) by the incoming tide. Willow oak in bloom.

May 6.—Garden white iris and wild blackberry in bloom.

May 8.—Oven bird and vireos singing. Hypoxis, potentilla, etc., in bloom.

May 10.—Whippoorwill singing.

May 13.—Wood pewee singing, and wild cherry in bloom.

In New England I have always regarded the coming of the wood pewee as a sure sign of settled summer weather.

May 14.—Locust trees in bloom. Hot and dry.

NOTES BY THE EDITOR.

DEATH OF MR. CYRUS ELLENBERGER.

In a letter dated San Francisco, Cal., April 6, 1900, Mr. Alexander G. McAdie says:

It is my sad duty to announce the death, on Thursday, April 5, of Mr. Cyrus Ellenberger, for many years a valued observer in the Weather Bureau. He had been on duty at this station since May, 1892, serving chiefly as chief clerk, and was regarded by all his associates as a painstaking, reliable, and faithful official. He gave the best years of his life to the work of the Weather Bureau, and was always willing to expend his energy in furthering the work of this office. For some time past he had suffered from a slow and painful disease, but he nevertheless very bravely stuck to his desk and performed the duties required of him.

STORM WAVES NOT TIDAL WAVES.

The Oregonian of Portland, Oreg., reports that a "tidal wave" did much damage at Ladysmith, Vancouver Island, April 6. On this same date severe storms and squalls prevailed on the coasts of Oregon, Washington, and British Columbia. The southwest winds accompanying such storms raise heavy seas and pile up the water in the rivers and harbors of this coast. All the reports that have been received from Victoria relative to the so-called tidal wave seem to show that it was due entirely to the wind, and might properly be called a "storm wave," but not in any sense a tidal wave. The latter class of waves have distinct characteristics and should not be confounded with the storm waves due to wind, and, occasionally, to barometric pressure.

AN ICE STORM.

During the month of March, of the current year, the vegetation in the New York Botanical Garden, on the Bronx